SEASONAL INCIDENCE OF *LEUCINODES ORBONALIS* (GUENEE.) ON BRINJAL AND EVALUATION OF INSECTICIDES AND BIOPESTICIDES

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ABSTRACT

The Current study investigated the seasonal incidence of the brinjal shoot and fruit borer, *Leucinodes orbonalis* and the effectiveness of selected insecticides and biopesticides. Peak shoot infestation reached 32.38 larvae/ plant by the third week of February (7th SMW),while fruit infestation peaked at 40.49 per plant in the second week of February (6th SMW). Shoot infestation correlated positively with maximum temperature (r=0.55*) and negatively with evening relative humidity (r=-0.74) and rainfall (r=-0.53*). Fruit infestation showed a strong negative correlation with evening relative humidity (r=-0.79***). Among the evaluated pesticides, Spinosad 45 SC was the most effective, reducing infestations to 9.58% for shoots and 8.56% for fruits, with a cost-benefit ratio of 1:13.5. This research contributes to understanding pest dynamics with season in brinjal cultivation, promoting sustainable production and profitability through effective pest management strategies.**

Key words: Shoot infestation, fruit infestation, February, correlation, maximum temperature, rainfall, relative humidity, spinosad, cost-benefit ratio, pest dynamics, sustainable, production, profitability, pest management

Brinjal, *Solanum melongena* (L.), commonly known as eggplant, is an important solanaceous vegetable widely cultivated in India andoften called as "king of vegetables". Brinjal significantly contributes to India's position with world's second-largest vegetable producer after China. India accounts for 57.31% of global vegetable production, with brinjal contributing 6.92%. India produces about 12,874,000 metric tons (MT) of brinjal from 749,000 ha, averaging 17.19 MT/ ha (National Horticulture Board, 2021). In Andhra Pradesh, a major producing state, brinjal cultivation covers 15,930 ha, yielding 414,150 MT with a higher productivity of 26 MT/ ha (National Horticulture Board, 2021). However, brinjal cultivation faces significant challenges from biotic stress, especially insect pests. (Sharma, 2018) identified 26 insect pests attacking brinjal in India, while globally, 140 insect pest species from 50 families across 10 orders have been reported. Among these pests, *Leucinodes orbonalis* Guenee, is particularly damaging, leading to yield losses of approximately 3 to 6 tons/ ha (Mollah et al., 2022a; Mollah et al., 2022b). The larval stage of *L. orbonalis* causes severe damage to shoots and fruits of eggplant. Larvae bore into young shoots, feeding on internal tissues, which leads to shoot wilting, reduced plant growth, and diminished fruit quantity, quality and size (Atwal and Dhaliwal, 2007). The extent of damage caused by*L. orbonalis* varies across different geographic locations and seasons can reach as high as 90.86% (Haq and Rizvi, 2023). Synthetic chemical insecticides have been the primary means of controlling this pest (Duara et al., 2003; Rahman et al., 2006). Frequent and indiscriminate use of insecticides can lead to an increase in insecticide resistance (Sharma et al., 2018). Biopesticides derived from plants can effectively manage insect populations in the field (Prabhu et al., 2022; Abbad et al., 2023). Given the limitations of current control methods and the significant economic impact of *L. orbonalis*, there is an urgent need for more effective and sustainable management strategies. This study aims to address this gap by investigating the infestation percentage of shoots and fruits and evaluating the efficacy of selected insecticides and biopesticides against *L. orbonalis*. The findings of this research could contribute to the development of more effective, economical, and environmentally friendly approaches to managing this destructive pest in brinjal cultivation.

MATERIALS AND METHODS

Two field experiments were conducted during the rabi season of 2020-21 at the Agricultural farm in Y. Kothapalli village, Kadiri Mandal, Sri Sathya Sai district, Andhra Pradesh (13.94° N, 78.68° E) to investigate the *L. orbonalis* infestation on brinjal. The dhruva variety of brinjal seedlings were raised in a nursery and transplanted after 26 days into main plots measuring 18 m x 8.8 m, with a spacing of 60 cm x 45 cm. The experiment followed a randomized block design (RBD) and standard agronomic practices, excluding insecticide application. Five plants/ plot were randomly selected and tagged for infestation assessment for that season. Weekly meteorological data from the agricultural research station, Kadiri, was used to correlate pest incidence with climatic factors. A separate field trial was conducted to evaluate the efficacy of selected insecticides and biopesticides against *L. orbonalis* on brinjal. The experimental unit plot size was 2 x 2 m, with a spacing of 60 cm x 45 cm. The following treatments were included: (T_0) untreated control; (T_1) imidacloprid 17.8 SL @ 1 ml/ l (T_2) *Bacillus thuringiensis var. krustaki* 0.5% WP @ 2 g/ l; (T3) Cypermethrin 25 EC @ 2 ml/ l; (T_4) Spinosad 45 SC @ 0.2 ml/ l; (T_5) *Metarhizium anisopliae* 2×10^8 spore/ ml @ 5 ml/ l; (T_6) Fipronil 5 SC @ 1 ml/ l; (T_7) azadirachtin 0.03% @ 5 ml/ l. The insecticide treatments (T_1 to T_7) were applied using a knapsack sprayer fitted with a hollow-cone nozzle. Observations were recorded before treatment application and at 3, 7, and 14 days post-spraying. Five plants were randomly selected and tagged in each plot for weekly assessments. Mature and tender fruits were harvested, weighed, and mean yields were calculated for each treatment. Additionally, a cost-benefit ratio was determined for each treatment. Statistical analysis was performed using R (version 4.1.3). Pearson's correlation analysis was conducted to investigate the relationship between pest incidence and climatic factors.

RESULTS AND DISCUSSION

In our study peak shoot infestation reached 32.38 larvae per plant by the 3rd week of February (7th SMW), while fruit infestation peaked at 40.49/ plant in the 2nd week of February (6th SMW) (Fig. 1). Fruit infestation, however, commenced approximately two weeks later (52nd SMW) compared to shoot infestation. These findings align with observations by (Indirakumar et al., 2016; Kadgonkar et al., 2018; Haq and Rizvi, 2023) who reported similar temporal patterns of infestation from November/ December through February. Further, correlation studies revealed shoot infestation was positively correlated with maximum temperature while, negatively with evening relative humidity and rainfall. Moreover, fruit infestation showed a strong negative correlation with evening relative humidity (Fig. 2). Remarkably, a highly significant positive correlation was observed between shoot and fruit infestation percentages, indicating that larvae causing initial shoot damage likely progress to fruit damage. These findings align with and expand upon previous research (Payal Devi 2013; Kadgonkar et al., 2018; Priti et al., 2022; Haq and Rizvi, 2023) reported similar correlation between weather parameters and the incidence of the *L. orbonalis*. Similarly, Panda et al. (2023) observed positive correlations with minimum temperature and negative, non-significant relations with morning relative humidity. Similarly, Maru et al. (2018) corroborated the negative correlation between *L. orbonalis* incidence and evening relative humidity. These collective findings highlight the complex interplay between climatic factors

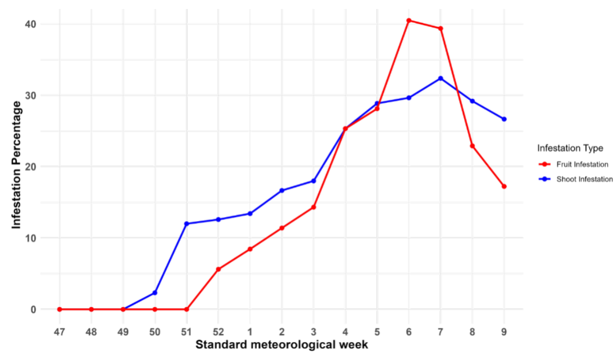
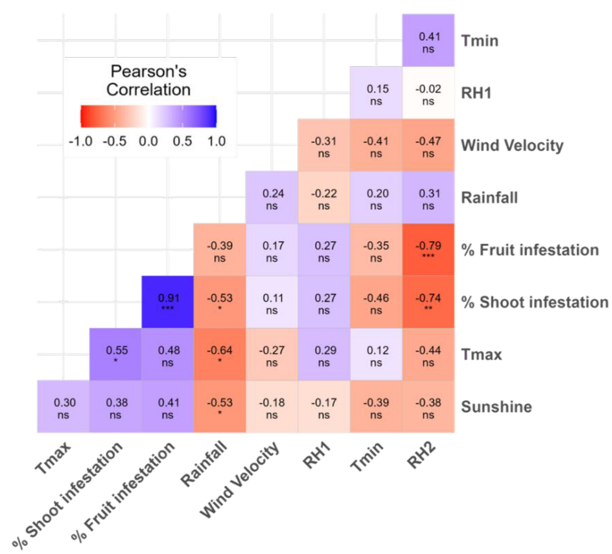


Fig. 1. Temporal dynamics of *Leucinodes orbonalis* infestation in brinjal during rabi season 2020-2021



ns p >= 0.05; * p < 0.05; ** p < 0.01; and *** p < 0.001

Fig. 2. Pearson's correlation coefficients depicting the relationships between key weather parameters and the incidence of *Leucinodes orbonalis* infestation in brinjal during rabi season 2020-2021

and *L. orbonalis* infestation patterns, emphasizing the potential for developing predictive models based on local weather patterns to anticipate and mitigate infestations in brinjal crops.

An evaluation of the efficacy of selected insecticides and biopesticides treatments against *L. orbonalis* conducted (Table 1). The experiment evaluated with seven different treatments against an untreated control, measuring their effects on shoot infestation, fruit infestation, yield, and cost-benefit ratio. In terms of shoot infestation, all treatments demonstrated notable level of efficacy compared to the untreated control. Among the treatments, spinosad 45% SC (T_4) emerged as the most effective, reducing shoot infestation to a low of 7.13% by the 7th DAS, though there was a slight increase to 9.58% by the 14th DAS. The untreated control observed with increase in infestation from 21.1% to 23.03% over the observation period. For fruit infestation also spinosad 45% SC proved most effective, reducing infestation to 7.17% by the 7th DAS, with a slight increase to 9.76% by the 14th DAS (Table 1). Similarly, minimum levels of shoot and fruit infestation (6.25%) were found in Spinosad treated plot of various studies (Mainali et al., 2018; Islam et al., 2019; Ghodake et al., 2024; Mahala et al., 2024)

All treatments resulted in higher yields compared to the untreated control (86.6 q/ha). Spinosad 45% SC not only provided the best pest control but also led to the highest yield of 230 q/ ha with the most favourable cost-benefit ratio of 1:13.5 (Table 1). Three spraying of Spinosad effectively controls the target pest, protects the crop, and reduces the need for additional control measures, providing a high return on investment in brinjal cultivation. Similar findings also observed by (Islam et al., 2019; Ghodake et al., 2024) where cost-benefit ratio was the highest in Spinosad 45 SC treated plot. Seasonality of the target crop, and local environmental conditions helps in identification of weak points in the insect's lifecycle that can be taken advantage of in combating the pest with relative ease and on a sustainable basis (Dar et al., 2017).

The study elucidated the seasonal incidence of *L. orbonalis* and their peak infestation periods with weather parameters with the effectiveness of selected insecticides and biopesticides. Spinosad was found most effective against *L. orbonalis* with high-cost benefit ratio. These findings offer invaluable insights to devise sustainable, cost-efficient pest management strategies, safeguarding brinjal yields and contributing to food security

Table 1. Efficacy of insecticides and biopesticides against brinjal shoot and fruit borer

Treatments	% shoot infestation				% fruit infestation				Yield of q/ha	C: B ratio
	One day before spray	After spray (DAS)			One day before spray	After spray (DAS)				
		3rd	7th	14th		3rd	7th	14th		
Untreated (T0)	21.66	22.43	23.80	25.42	21.1	21.99	22.77	23.03	86.6	01:05.5
Imidacloprid 17.8 SL (T1)	19.99	10.55	9.08	11.99	18.32	9.00	8.21	10.47	200.5	01:12.2
B.t var. krustaki 0.5%WP (T2)	21.77	16.77	15.23	17.17	18.32	15.44	14.45	15.57	170	01:10.6
Cypermethrin 25 EC (T3)	18.55	11.55	12.40	13.38	17.79	10.44	9.33	11.14	198.3	01:12.2
Spinosad 45% SC (T4)	21.10	8.83	7.13	9.58	20.55	8.77	7.17	9.76	230	01:13.5
M. anisopliae 2 x 10^8 spore/ ml (T5)	22.71	19.22	18.07	20.87	19.99	18.55	17.34	19.12	131.6	01:07.9
Sixer plus (T6)	19.44	14.22	13.74	15.21	20.55	13.77	12.11	14.61	186.6	01:11.5
Azadirachtin 0.03% EC (T7)	22.01	20.55	19.38	21.34	21.66	19.88	18.12	20.63	115	01:07.0
LSD (p =0.05)	5.17	2.28	1.49	1.66	3.18	1.92	2.06	2.10		

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AUTHOR CONTRIBUTION STATEMENT

G R, K S I L, C N R, B V J, – plan of work and statistical analysis. KRM, M S, C M – contribution in writing the manuscript. All authors read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest

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